Welcome to

Capability Maturity Model Overview

Presented by: DSDC

For more info, send requests to:
sepg@dsdc.dla.mil

DSDC

CUSTOMER

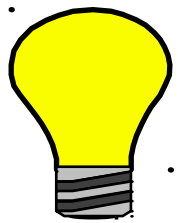
PARTNERS in Quality Solutions

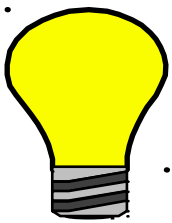
INDUSTRY

Course Objectives

This course will introduce the student to the Software Process Capability Maturity Model. At the end of the course, the student will be able to:

- Identify the terms used with the Capability Maturity Model.
- Recognize the elements of the Capability Maturity Model.
- Recognize each of the five levels of the Capability Maturity Model
- Recognize how the CMM fits in with current and future organizational information systems development projects.
- Understand the difference between assessments and evaluations





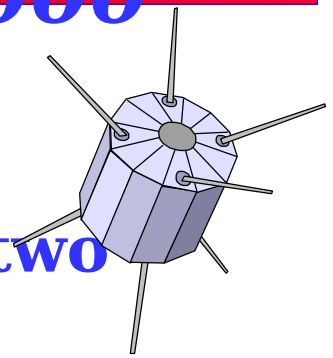
DSDC

CUSTOMER

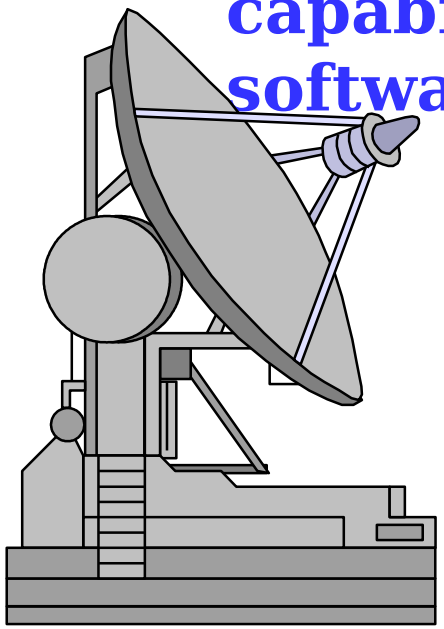
PARTNERS in Quality Solutions

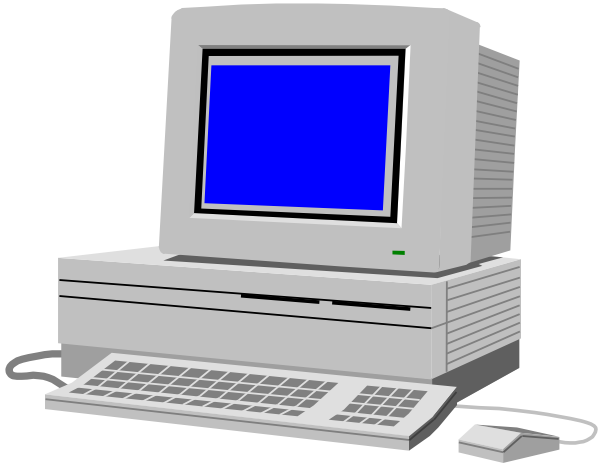
INDUSTRY

DoD Objectives for its software community to achieve by the year 2000



- Reduce life-cycle costs by a factor of two
- Reduce software problem rates by a factor of ten
- Achieve new levels of DoD mission capability and interoperability via software





DSDC

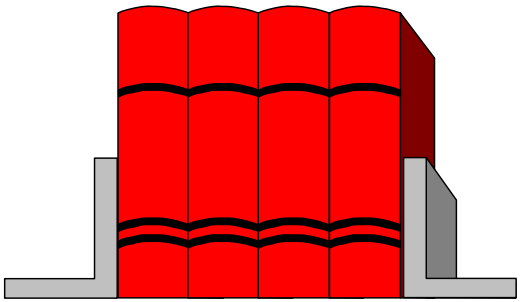
CUSTOMER

PARTNERS in Quality Solutions

INDUSTRY

Additional Readings

- ***Capability Maturity Model for Software,*** **Software Engineering Institute, CMU/SEI-93-TR-24, Aug '91, Feb '93**
- ***Key Practices of the Capability Maturity Model,*** **Software Engineering Institute, CMU/SEI-93-TR-25, Aug '91, Feb '93 BOTH AVAILABLE AT:** *http://www.dataweb.net/~lodewijk/SEI_CMM/*
- ***Managing the Software Process,*** **Watts S. Humphrey, Addison Wesley, 1990**
- ***The Capability Maturity Model: Guidelines for Improving the Software Process,*** **Mark Paulk et al, Addison-Wesley, 1995**



Course Topics

- Software Process Management
- The Capability Maturity Model
- Understanding the Initial and Repeatable Levels
- Understanding the Defined Level
- Understanding the Managed and Optimizing Levels
- Assessments and Evaluations
- Conclusion and Discussion

Software Process Management

Define Software:

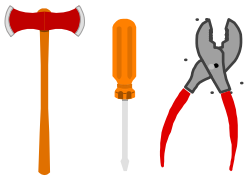
Define Process:

Define Software Process Improvement:

Software Process Management

Software Engineering Institute's Definition of Process

The means by which people, procedures, methods, equipment, and tools are integrated to produce a desired end result.



People with skills, training, and motivation

Tools and equipment

Procedu defining the rela of tasks

DSDC

CUSTOMER

PARTNERS in Quality Solutions

INDUSTRY

Software Process Management

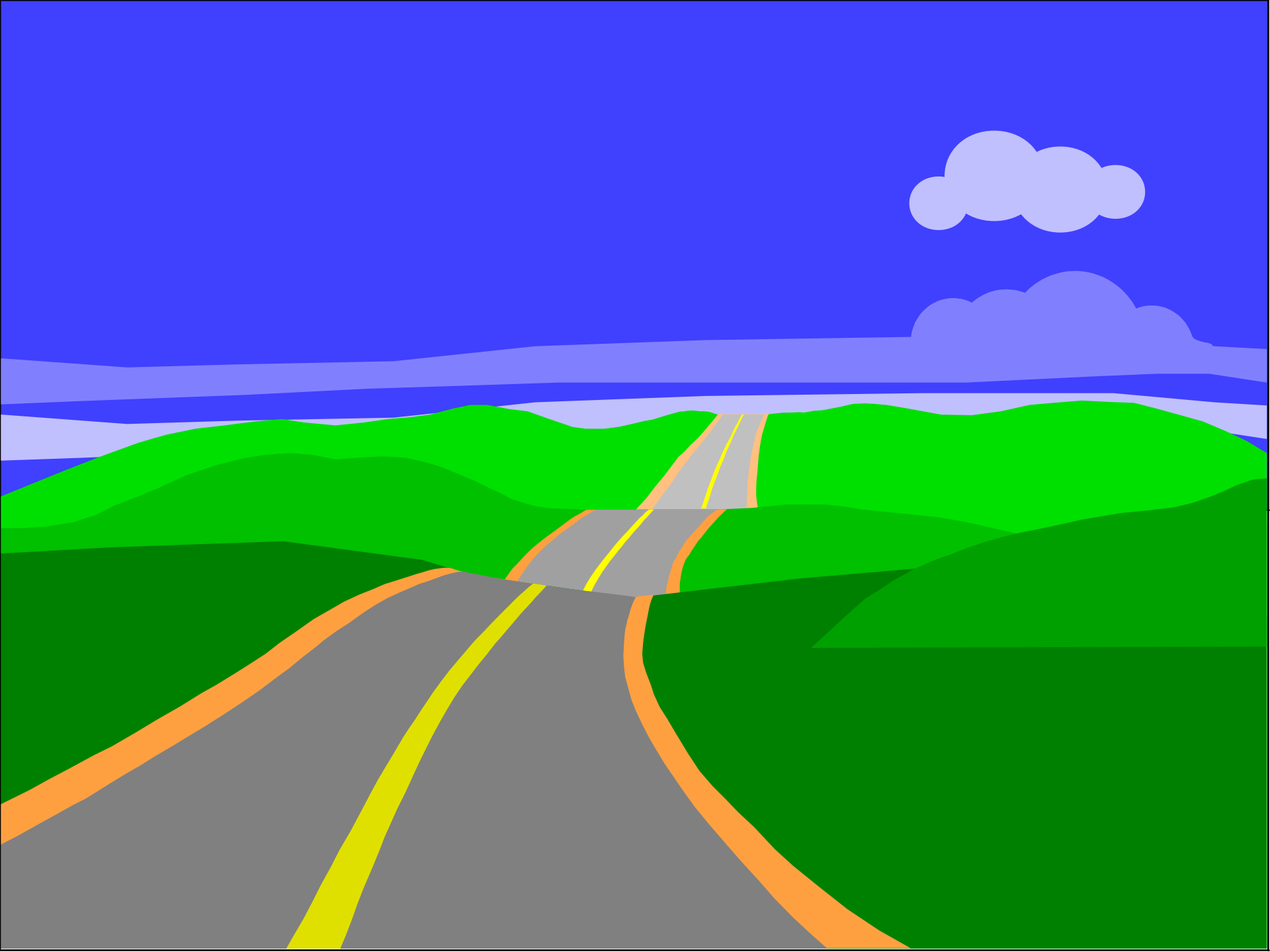
Life Cycle Phases:

- ⇒ Initiation
- ⇒ Development
  - Analysis
  - Design
  - Programming
- ⇒ Evaluation
- ⇒ Operations

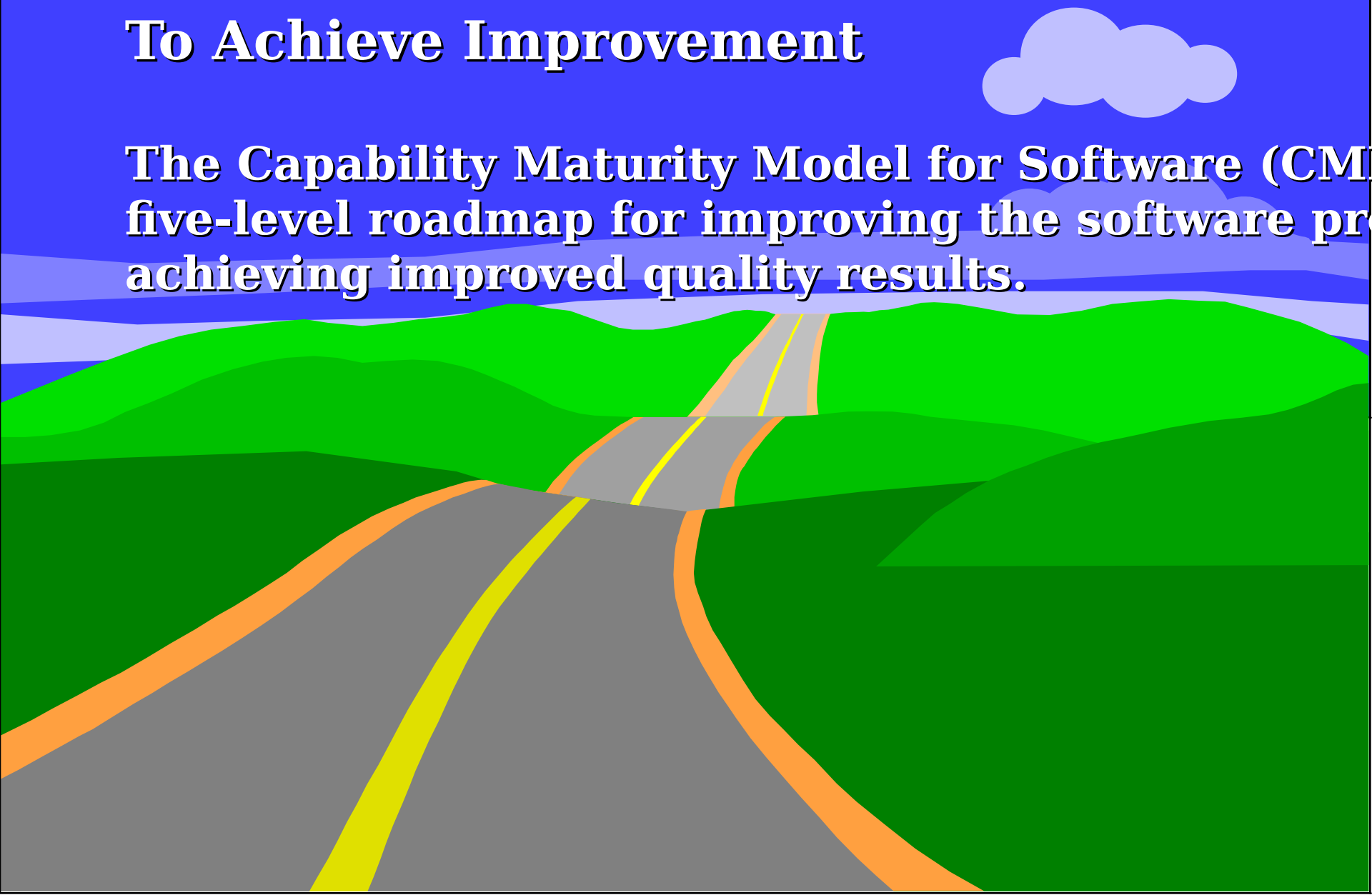
Software Process Management

To Achieve Improvement

**The Capability Maturity Model for Software (CMM
five-level roadmap for improving the software pro
achieving improved quality results.**



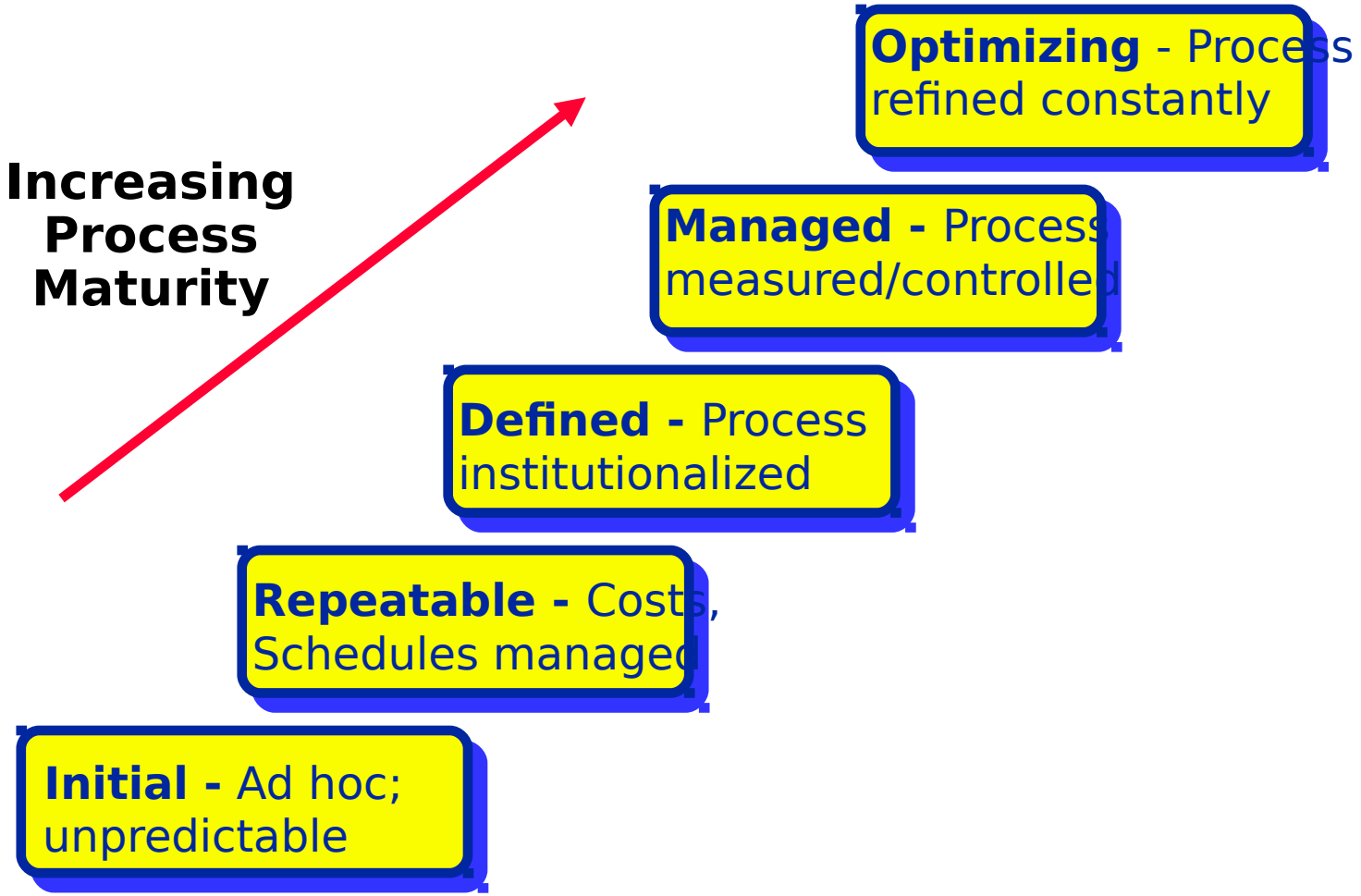
To Achieve Improvement



The Capability Maturity Model for Software (CM
five-level roadmap for improving the software pr
achieving improved quality results.

Software Process Management

Capability Maturity Model Overview


Increasing Process Maturity
Optimizing - Process refined constantly
Managed - Process measured/controlled
Defined - Process institutionalized
Repeatable - Costs, Schedules managed
Initial - Ad hoc; unpredictable

The Capability Maturity Model

What is the Capability Maturity Model (CMM)?

The application of process management and quality improvement concepts to software development and maintenance.

A guide for evolving toward a culture of engineering excellence.

A model for organizational improvement.

The Capability Maturity Model

The CMM Community

CMM provides a principled, public model for appraising software development capability.

CMM owned by national software community (and is being accepted abroad.

SEI exercises stewardship over the CMM

- **evolves CMM from industry and government experience**
- **performs empirical research**
- **develops CMM-based improvement methods**

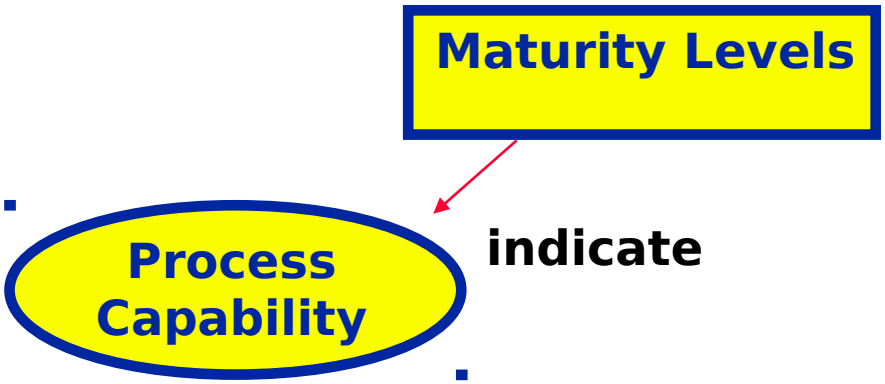
The Capability Maturity Model

The CMM Structure

Maturity Levels

The Capability Maturity Model

The CMM Structure



The Capability Maturity Model

Maturity Levels

A *maturity level* is a well-defined evolutionary plateau on

the path toward becoming a mature software organization.

- **each level is a layer in the foundation for continuous process improvement**
- **there are five maturity levels in the CMM**

***Process capability* describes the range of expected results from following a process.**

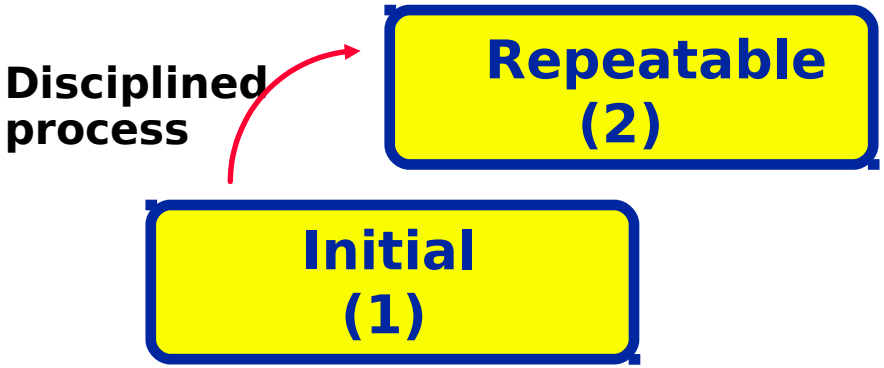
The Capability Maturity Model

The Five Maturity Levels

Initial
(1)

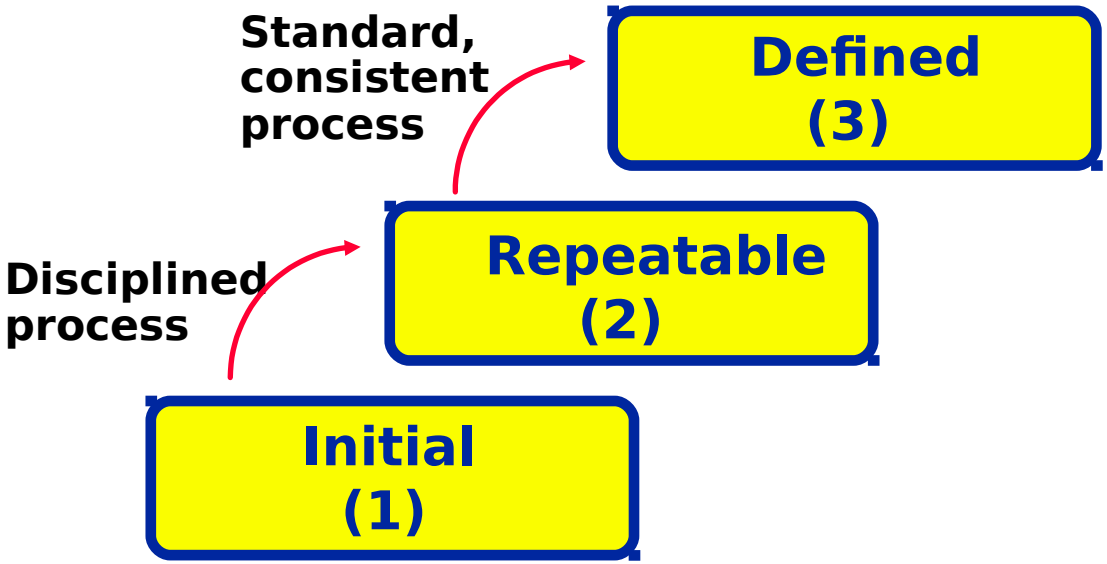
The Capability Maturity Model

The Five Maturity Levels



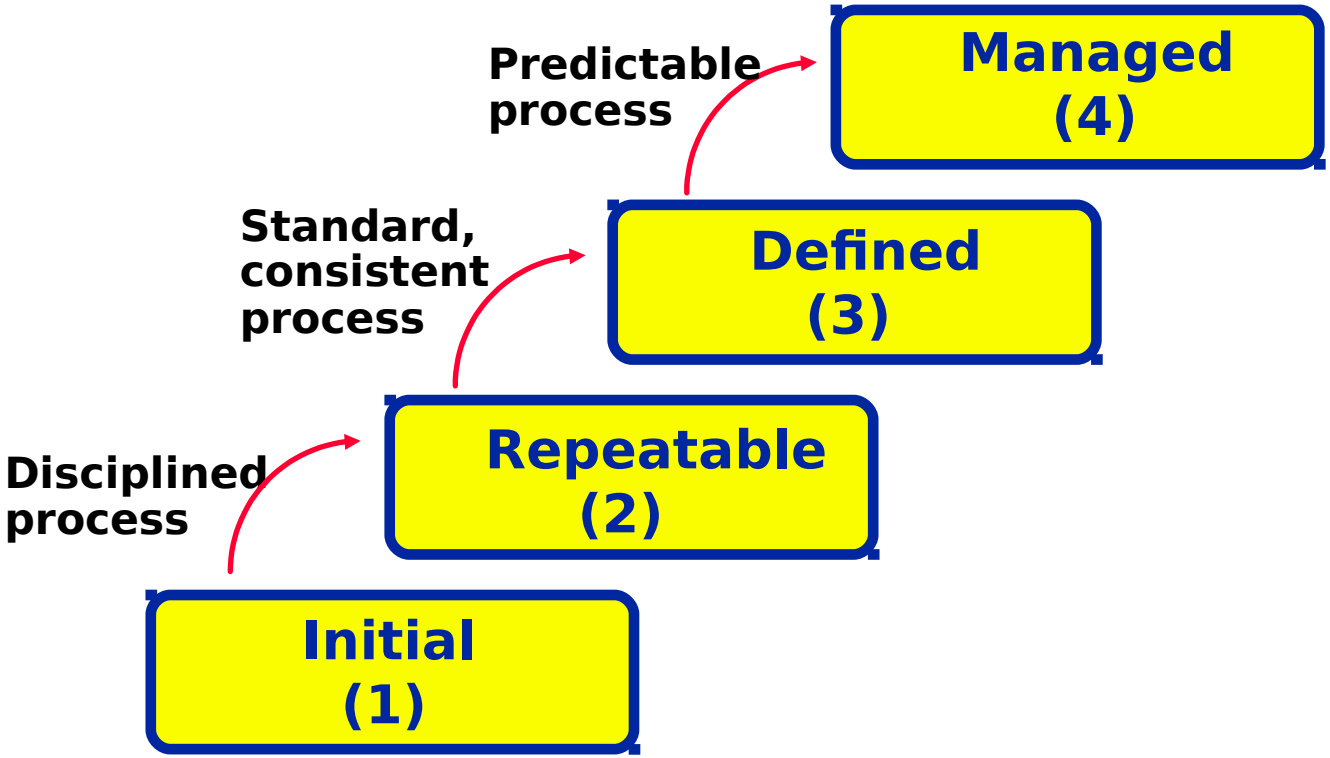
The Capability Maturity Model

The Five Maturity Levels



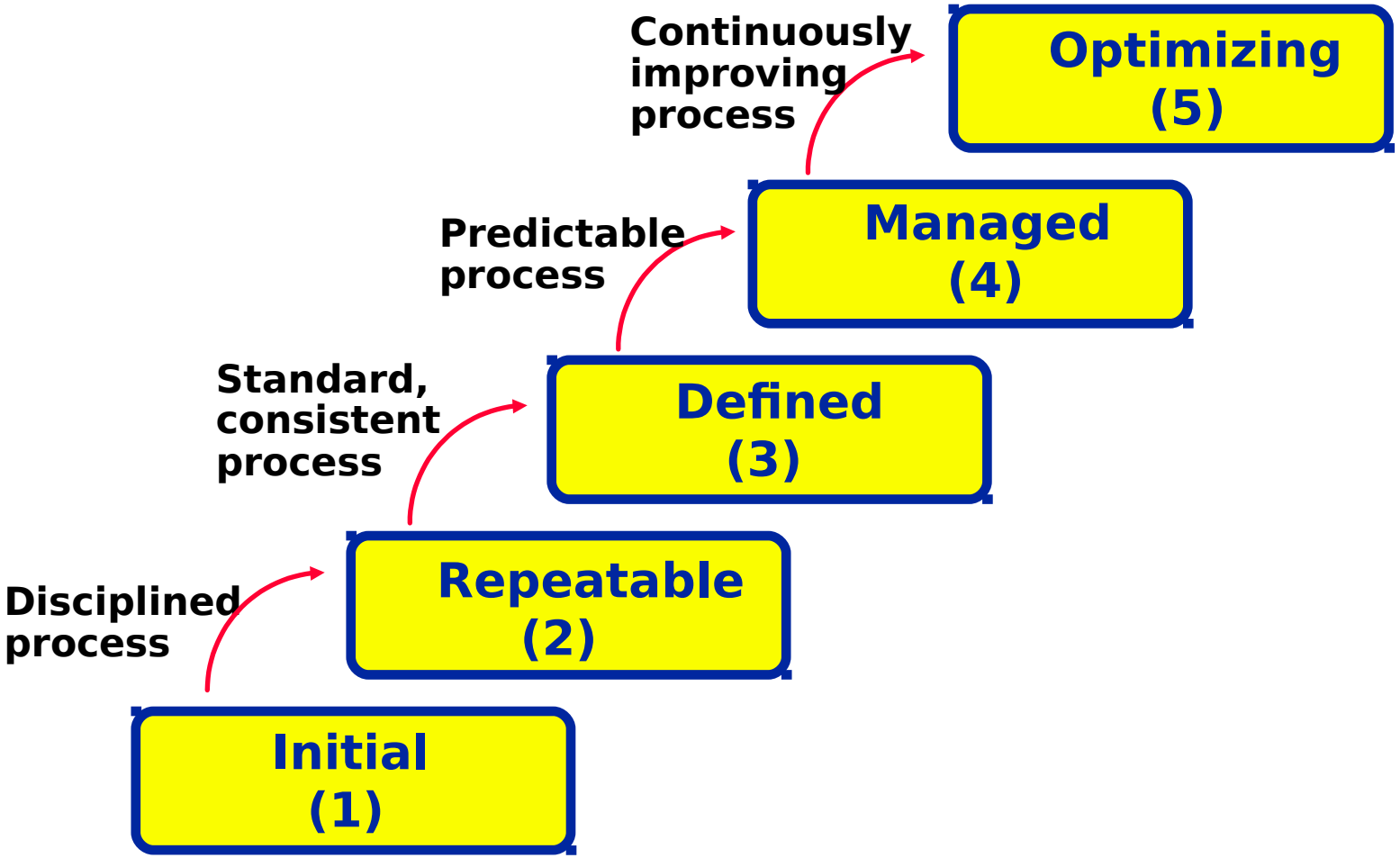
The Capability Maturity Model

The Five Maturity Levels



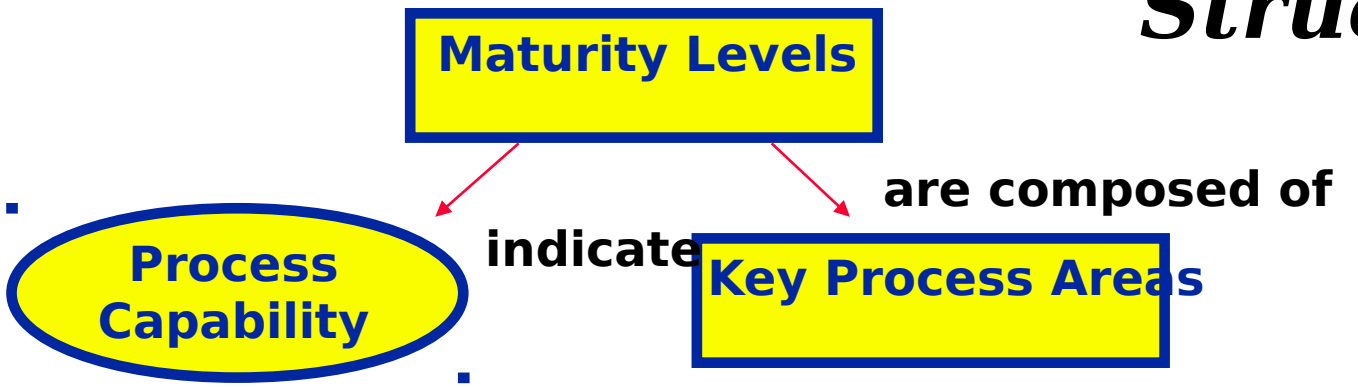
The Capability Maturity Model

The Five Maturity Levels



The Capability Maturity Model

The CMM Structure



The Capability Maturity Model

Key Process Areas

Key process areas **are the major building blocks in establishing the process capability of an organization.**

They are a cluster of related activities performed collectively to achieve a set of goals

DSDC

CUSTOMER

PARTNERS in Quality Solutions

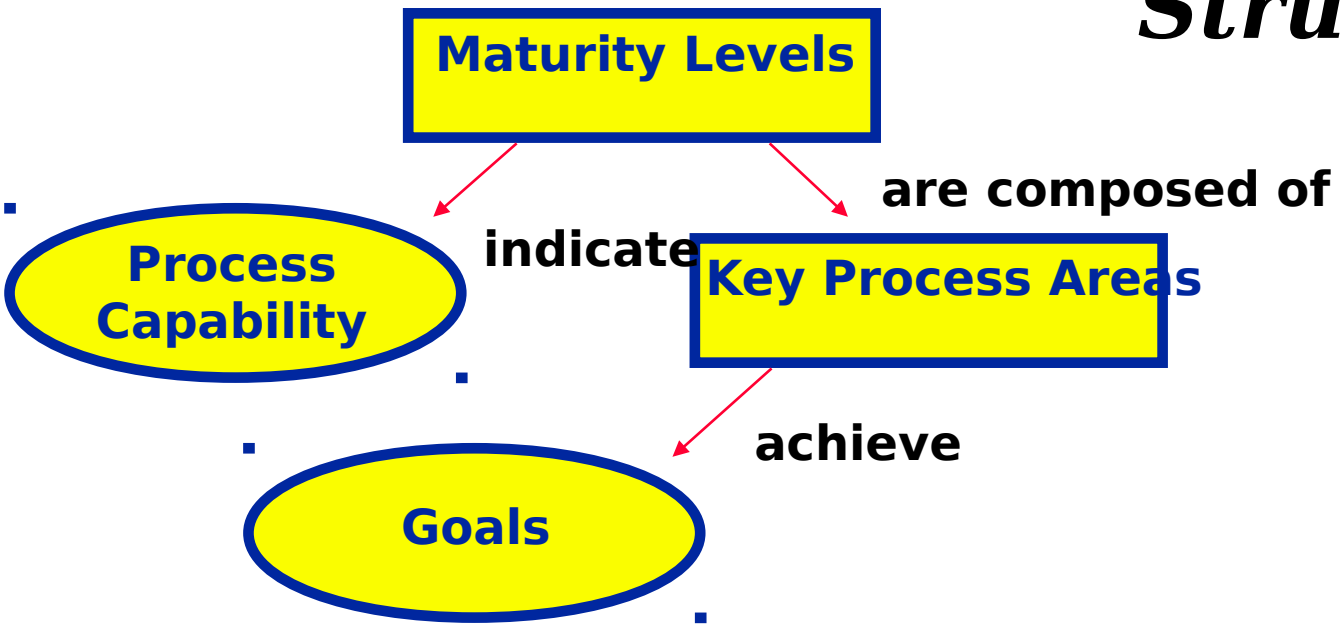
INDUSTRY

The Capability Maturity Model

Optimizing (5)	**Continuous Process improvement**	
Managed (4)	**Product & process quality**	
Defined (3)	**Engineering process**	
Repeatable (2)	**Project management**	
Initial (1)		

The Capability Maturity Model

The CMM Structure



The Capability Maturity Model

An Example of Goals:

Software Project Planning

Software estimates are documented for use in planning and tracking the software project.

Software project activities and commitments are planned and documented.

Affected groups and individuals agree to their commitments related to the software project.

The Capability Maturity Model

Example Maturity Questions on Size Estimating

Do you use a documented procedure to estimate software size (e.g. lines of code, function points, etc..)?

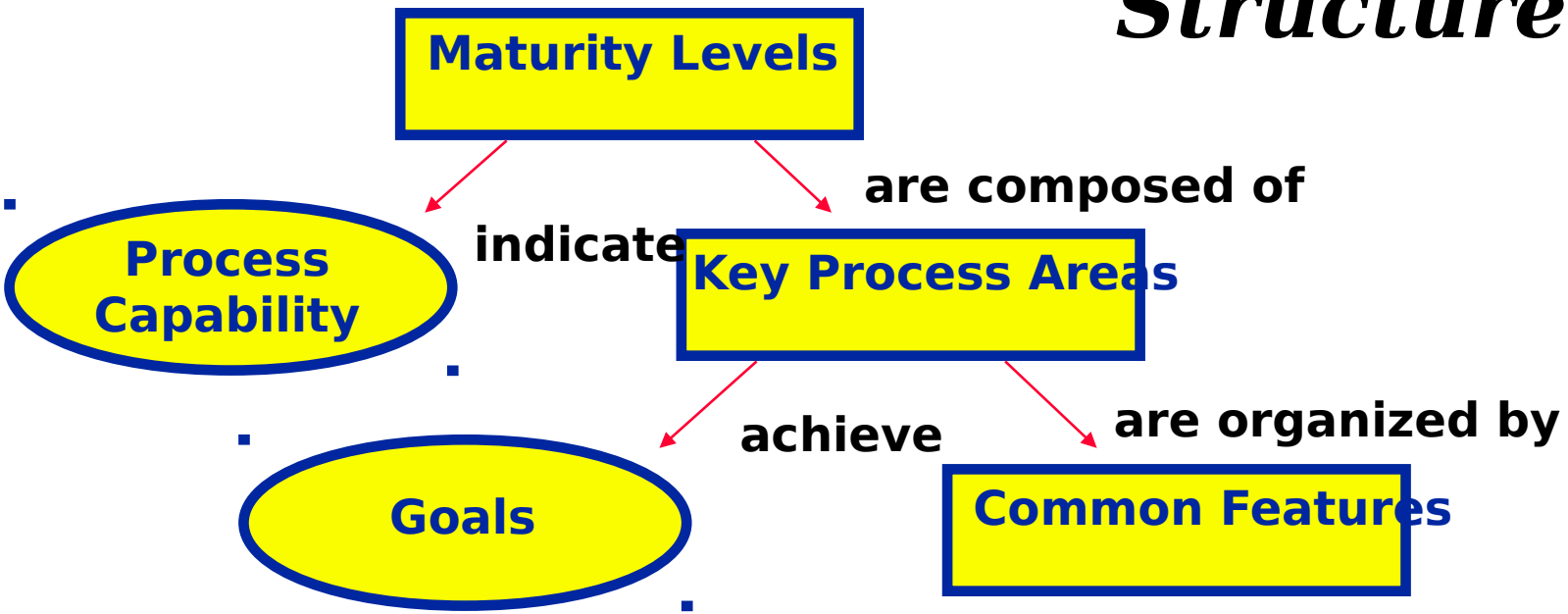
Do you use historical size data, when available, to help derive software size estimates?

Do you document the assumptions made in estimating software size?

Do you review software size estimates?

The Capability Maturity Model

The CMM Structure



The Capability Maturity Model

Key Process Area Common Features

- Commitment to Perform
- Ability to Perform
- Activities Performed
- Measurement and Analysis
- Verifying Implementation

The Capability Maturity Model

Commitment to Perform

- Describes the actions an organization must take to ensure the process is established and will endure.
- Typically involves establishing organizational policies and senior management sponsorship.

The Capability Maturity Model

Ability to Perform

- Describes the preconditions that must exist to implement the process competently.
- Typically involves resources, organizational structures, and training.

The Capability Maturity Model

Activities Performed

- Describes the roles and procedures necessary to implement a Key Process Area.
- Typically involves establishing plans and procedures, performing the work, tracking it, and taking corrective actions as necessary.

The Capability Maturity Model

Measurement and Analysis

- Describes the need to measure the process and analyze the measurements.
- Typically includes examples of the measurements that could be taken to determine the status and effectiveness of the Activities Performed.

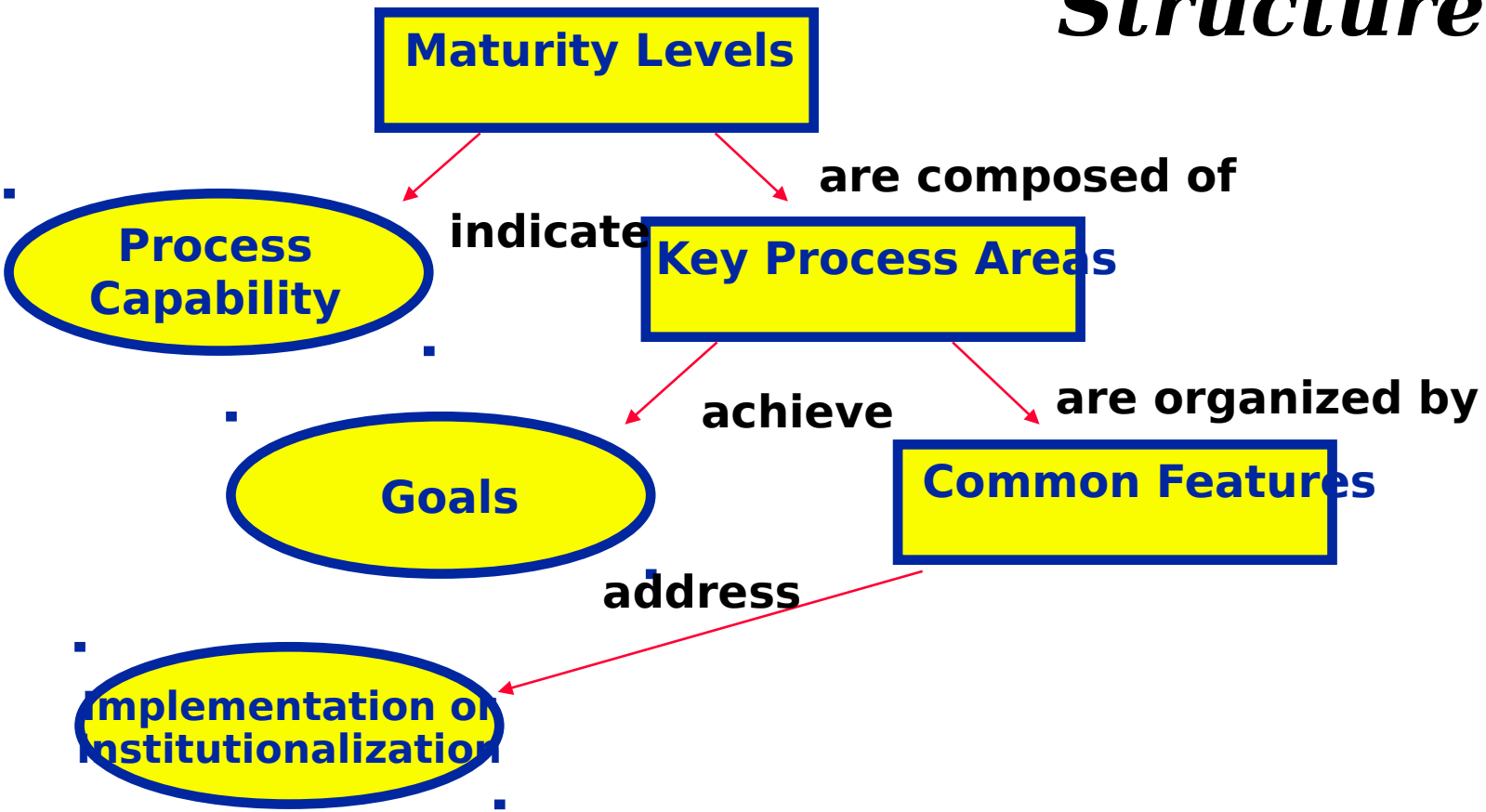
The Capability Maturity Model

Verifying Implementation

- Describes the steps to ensure that the activities are performed in compliance with the established process.
- Typically encompasses reviews and audits by management and software quality assurance.

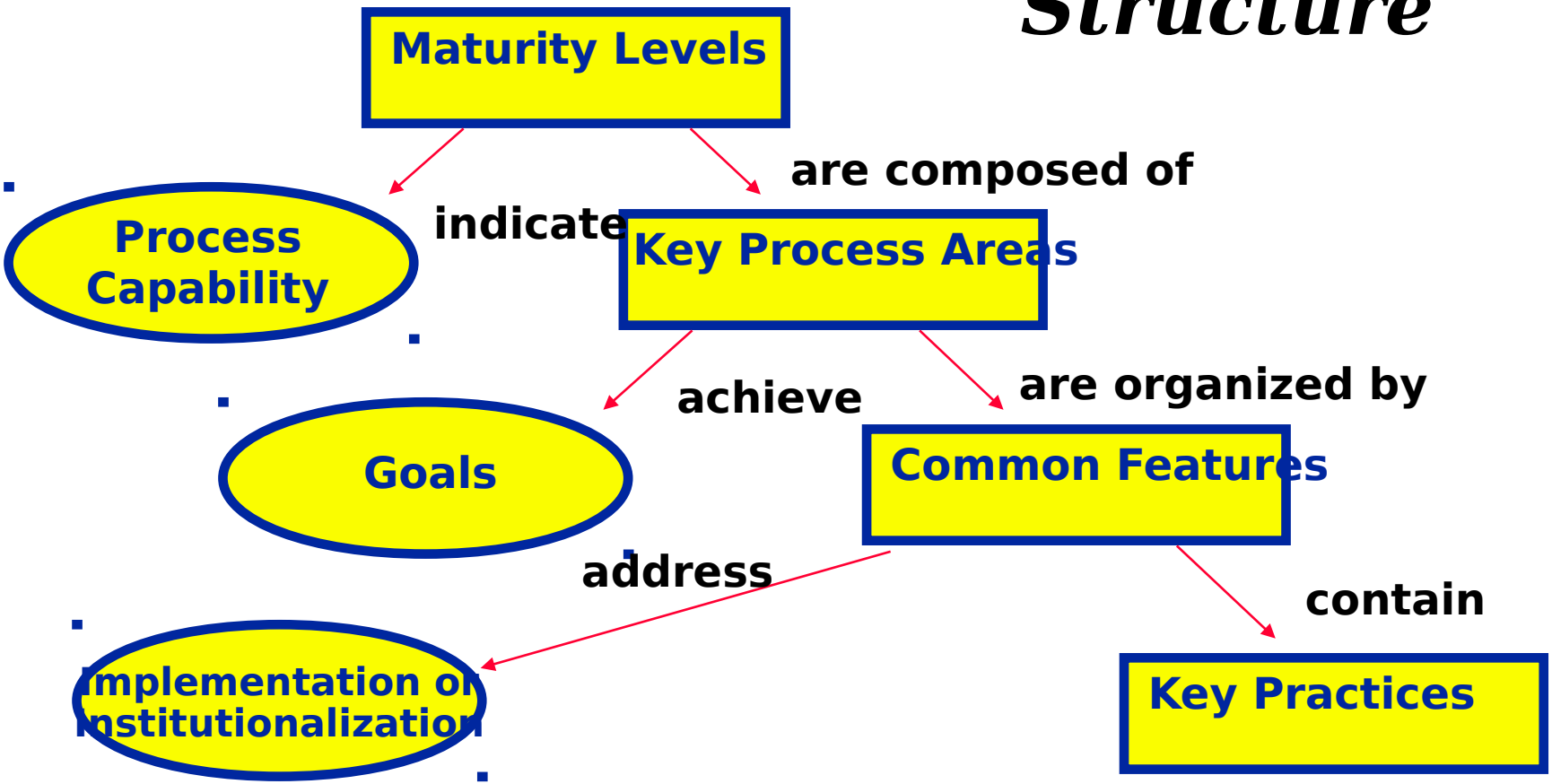
The Capability Maturity Model

The CMM Structure



The Capability Maturity Model

The CMM Structure



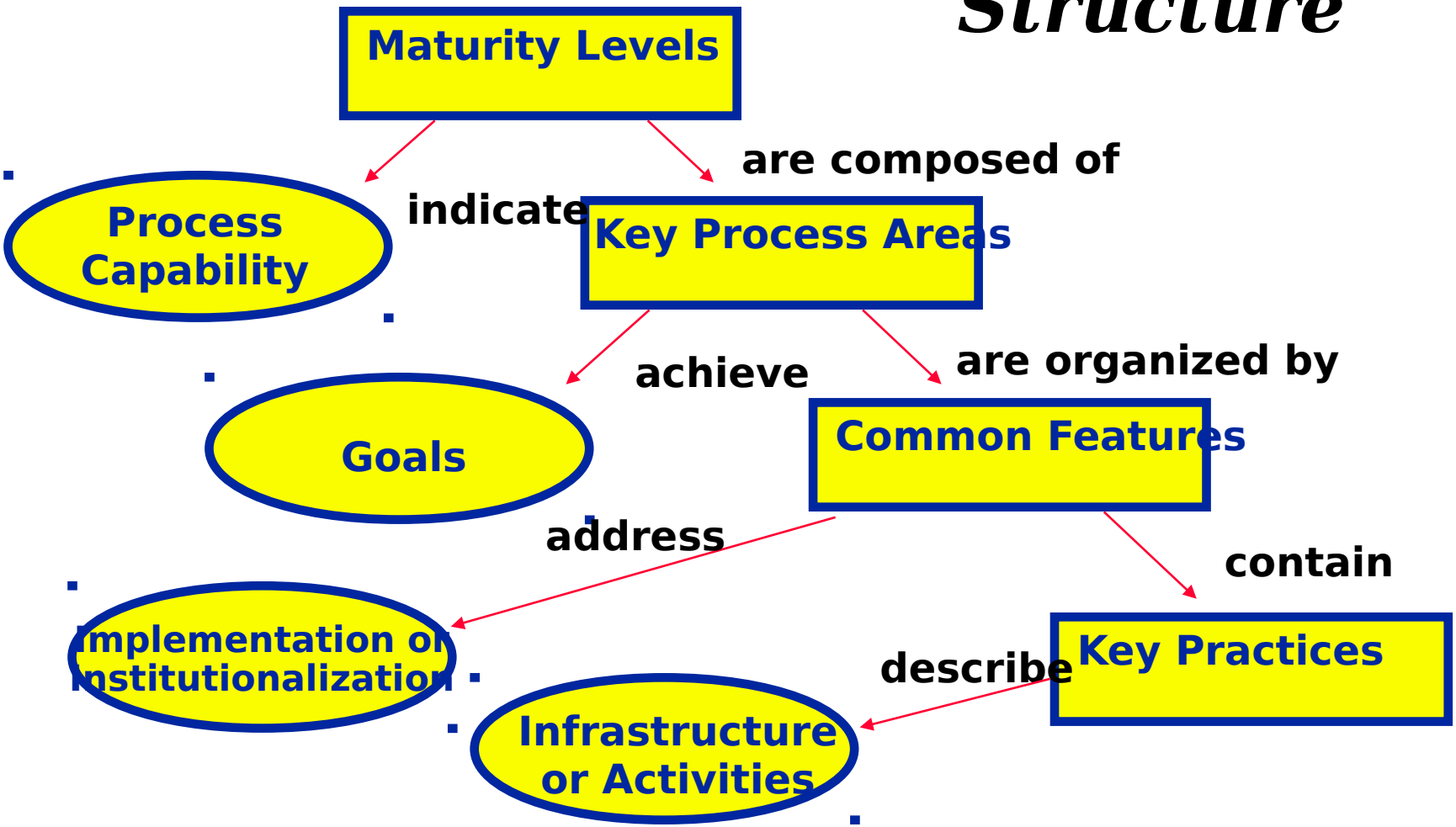
The Capability Maturity Model

Key Practices

Key practices **are the policies, procedures, and activities that contribute most to the effective institutionalization and implementation of the key process area.**

The Capability Maturity Model

The CMM Structure



The Capability Maturity Model

An Example Key Practice:

Size Estimating

Software Project Planning

Activity 9 **Estimates for the size of the software work products (or changes to the size of software work products) are derived according to a documented procedure:**

This procedure typically specifies that ....

The Initial Maturity Level

Understanding the Initial Maturity Level

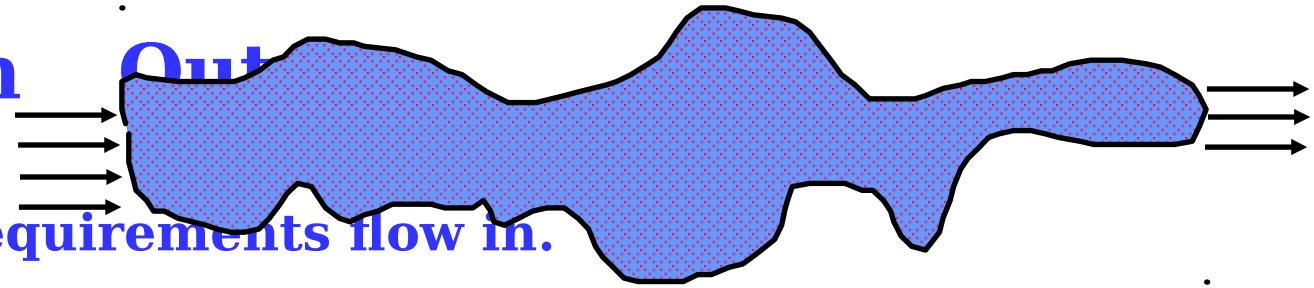
Performance driven by the competence and heroics of the people doing the work.

Consistency and compliance to standards driven by management priorities - usually schedule is the top priority.

High quality and exceptional performance possible so long as the best people can be hired.

The Initial Maturity Level

The Management View of the Software Process at Level 1



Requirements flow in.

A software product is (usually) produced by some amorphous process.

The product flows out and (hopefully) works.

The Repeatable Maturity Level

Understanding the Repeatable Maturity Level

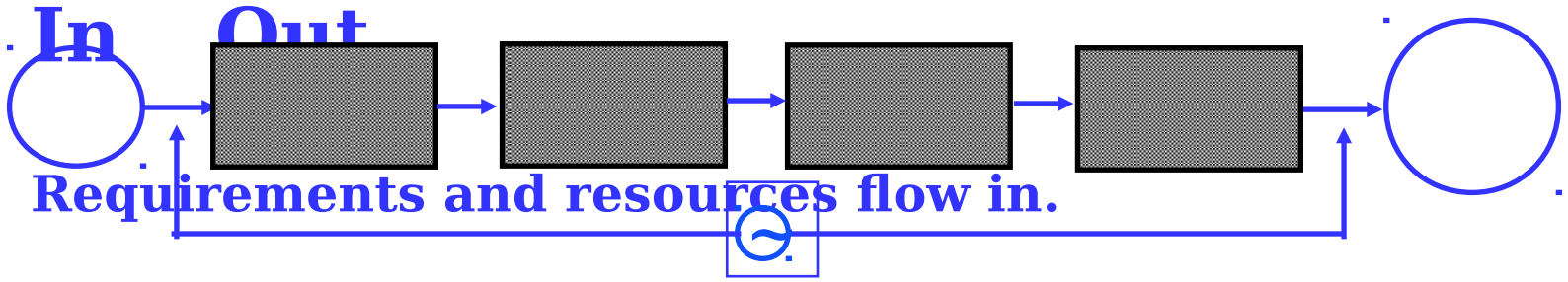
The major problems in software development are managerial - not technical.

Management must “walk their talk” to initiate an improvement effort.

Without management discipline, good software engineering practices typically are abandoned in the crunch.

The Repeatable Maturity Level

The Management View of the Software Process at Level 2



Requirements and resources flow in.

The production of the software product is visible at defined points.

Artifacts of the process are controlled.

The Repeatable Maturity Level

The Key Process Areas for the Repeatable Level (2)

Repeatable (2)

- Software configuration management
- Software quality assurance
- Software subcontract management
- Software Project Tracking and Oversight
- Software Project Planning
- Requirements Management

DSDC

CUSTOMER

PARTNERS in Quality Solutions

INDUSTRY

Group Activity

The Defined Maturity Level

Understanding the Defined Maturity Level

To control a process, it must be well understood.

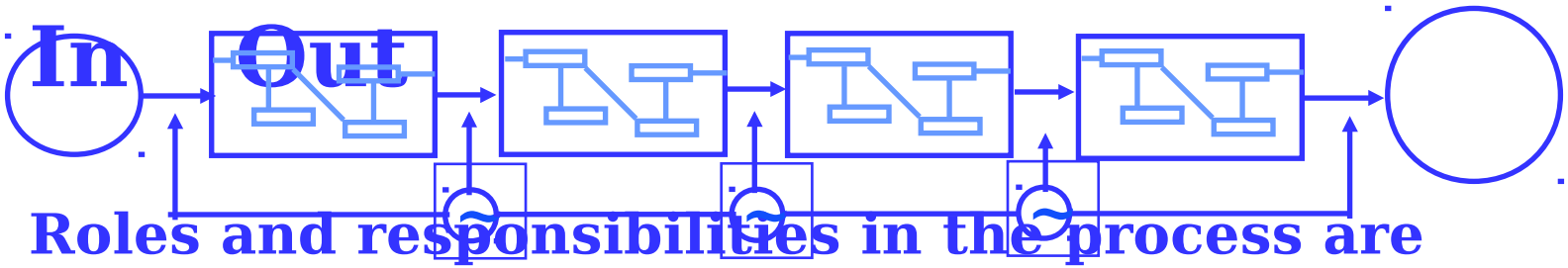
Identify the inputs, how they will affect the process, and their readiness criteria.

Identify the outputs and the completion criteria for the outputs.

Establish a shared understanding of how the process works and the role of each participant.

The Defined Maturity Level

The Management View of the Software Process at Level 3



Roles and responsibilities in the process are understood.

The production of the software product is visible throughout the software process.

The Defined Maturity Level

The Key Process Areas for the Defined Level (3)

Defined (3)

- Peer Reviews
- Intergroup coordination
- Software product engineering
- Integrated software management
- Training program
- Organization process definition
- Organization process focus

The Managed Maturity Level

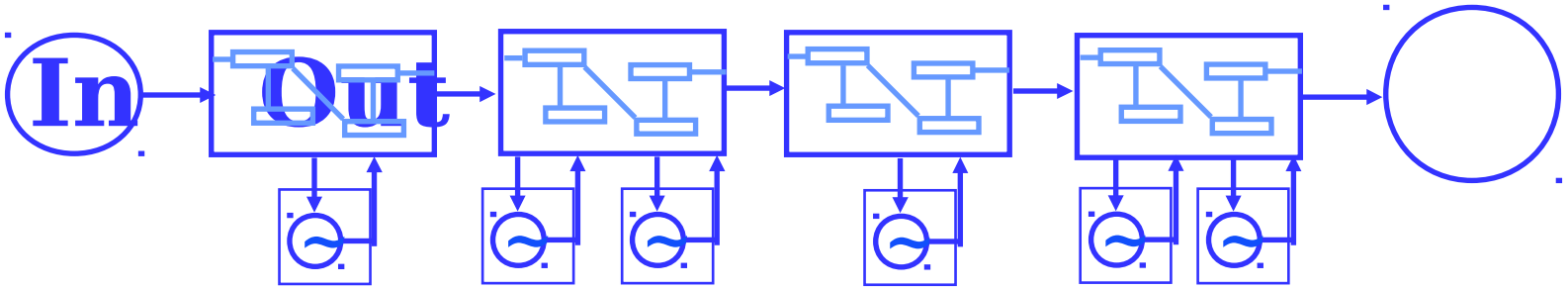
Understanding the Managed Maturity Level

Applying the principles of statistical process control, address special causes of process variation.

Quantitatively address the organization's, customer's and end user's quality goals as part of a philosophy of quality management.

The Managed Maturity Level

The Management View of the Software Process at Level 4



The production of the software product is quantitatively understood throughout the software process.

The Managed Maturity Level

The Key Process Areas for the Managed Level (4)

Managed (4)

Software quality management
Quantitative process management

The Optimizing Maturity Level

Understanding the Optimizing Maturity Level

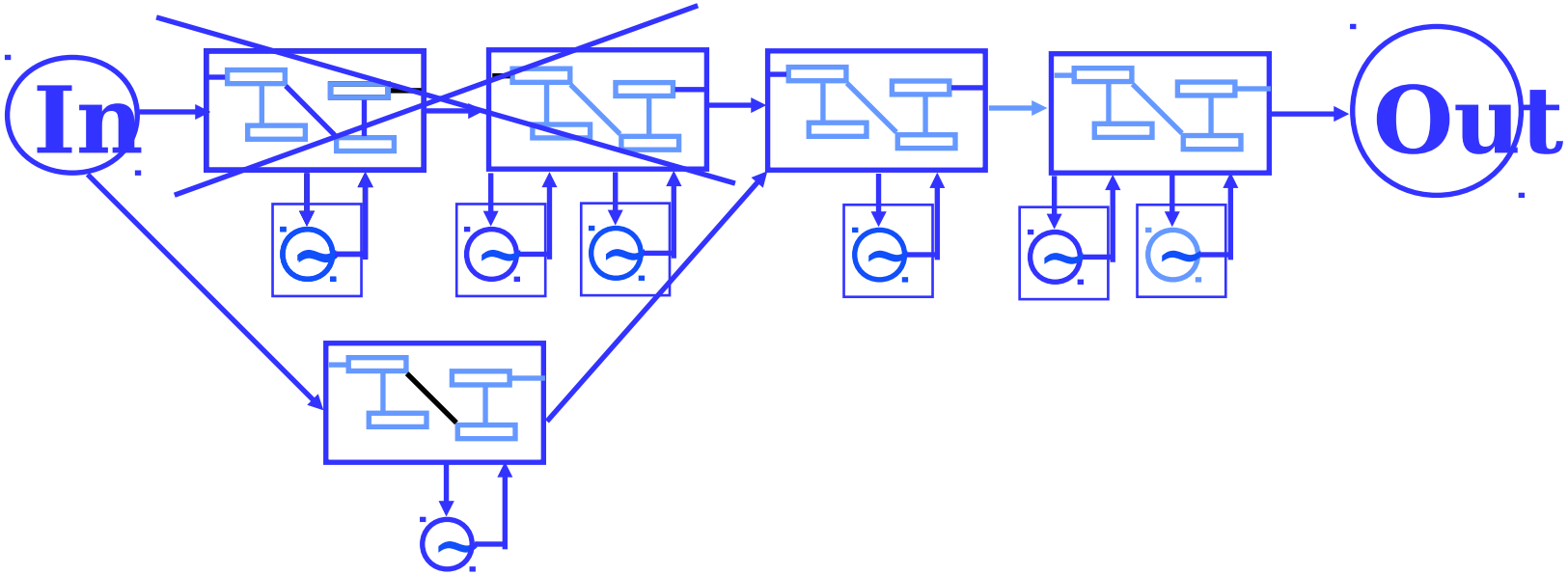
Automation and trying new technologies

Identify and eliminate chronic causes of poor performance

Continually improve the software process

The Optimizing Maturity Level

The Management View of the Software Process at Level 5



The software process is continuously improved controlled manner

The Optimizing Maturity Level

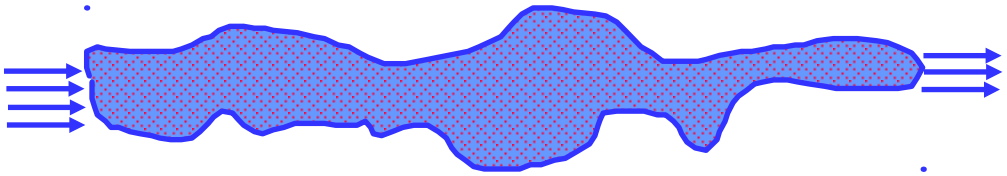
The Key Process Areas for the Optimizing Level (5)

Optimizing (5)

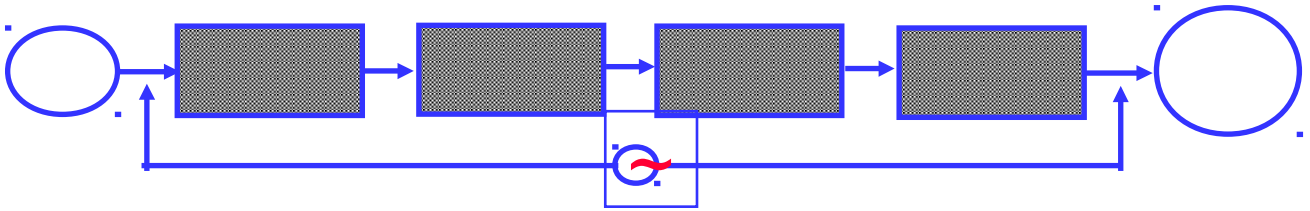
Process change management
Technology change management
Defect prevention

Management View of the Maturity Levels

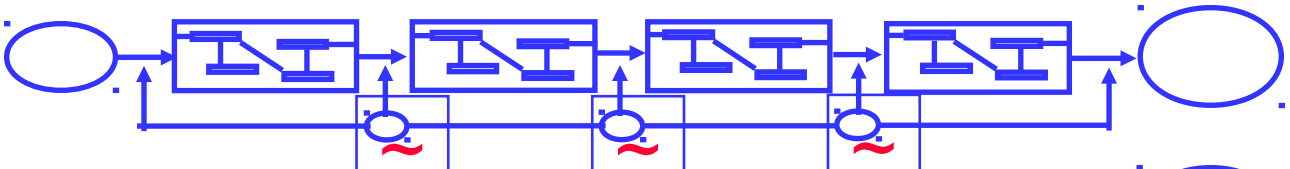
ML 1



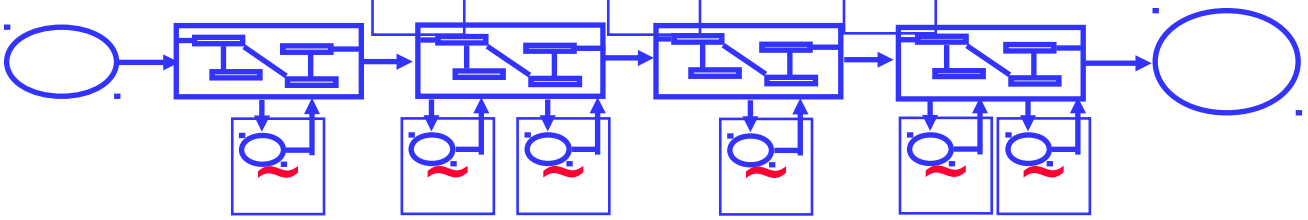
ML 2



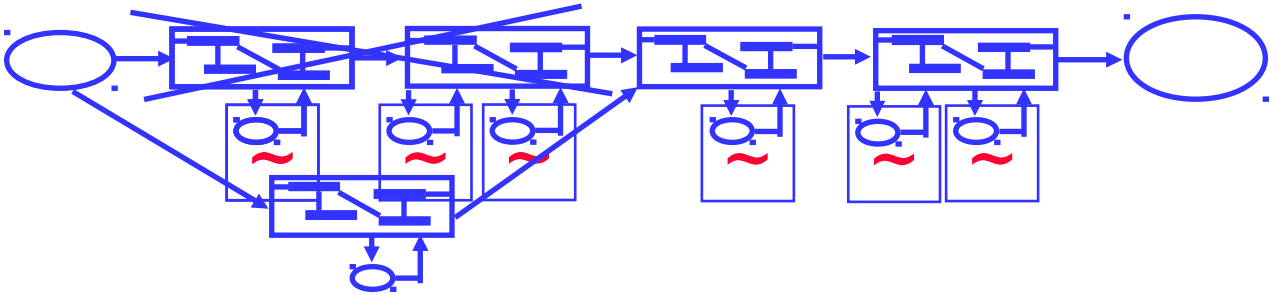
ML 3



ML 4



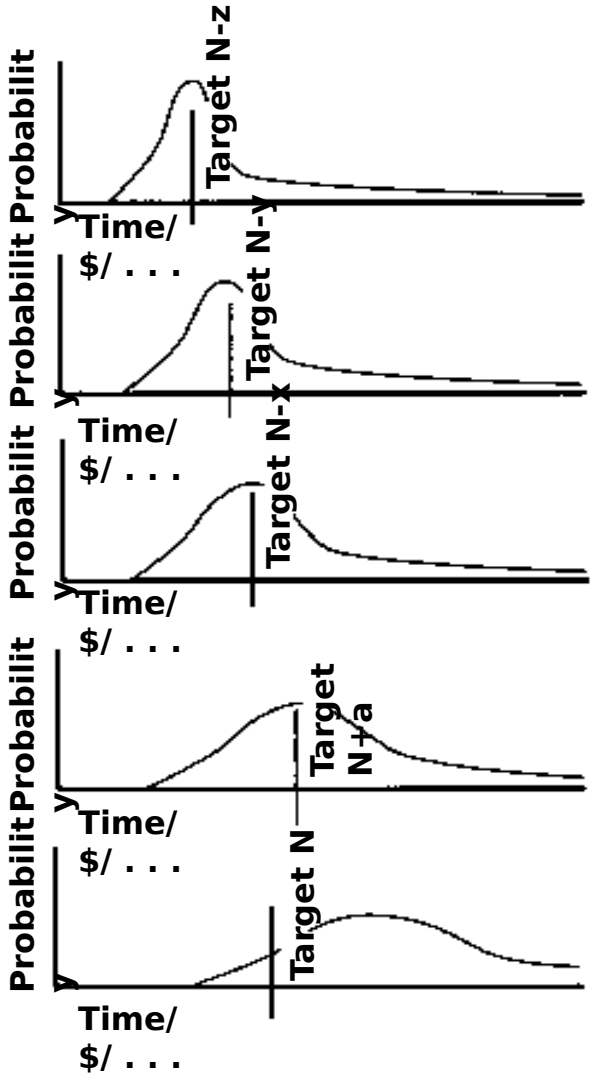
ML 5



DSDC CUSTOMER PARTNERS in Quality Solutions INDUSTRY

Process Capability as Indicated by Maturity Level

Levels



Performance continuously improves in Level 5 organizations

Based on quantitative understanding of process and product, performance continues to improve in Level 4 organizations

With well-defined processes, performance improves in Level 3 organizations

Plans based on past performance are more realistic in Level 2 organizations

Schedule and cost targets are typically overrun by Level 1 organizations

DSDC PARTNERS in Quality Solutions
CUSTOMER
INDUSTRY

Assessment vs Evaluation

A Comparison

Assessments

- Organization uses to improve the software process
- Results confidential
- Assesses current practice
- Acts as a catalyst for process improvement
- Provides input for improvement action plan
- Findings may include issues not explicit in maturity model
- Collaborative -- members of organization must be on the team
- Applies to organization, not individual projects, contracts

Evaluations

- Used by DoD in source selection, contract monitoring
- Results known to DoD
- Substantiates current practice
- Assesses contractor commitment to improve
- Analyzes contract performance potential
- Findings restricted to CMM issues
- Audit oriented -- members of the organization not on team
- Applies to performance on one specific contract

-- Adapted from SEI Training

A Foundation, Not a Destination

- **The optimizing level is not the destination of process management.**
- **The destination is better products for a better price: economic survival.**
- **The optimizing level is a foundation for building ever-improving capability**

from SEI Training

Process Improvement is Continuous Improvement

- **We can never reach perfection.**
- **The CMM does not provide all the answers; it too is evolving and improving.**
- **Process management means constructive and continual improvement.**
- **The focus is on always doing better.**
- **Our reach should always exceed our grasp**

from SEI Training

Quality is NOT Free…

Improvement requires investment.

- **a vision of what you want**
- **commitment, planning and resources**

… but quality is cheaper than the alternatives

The capability maturity model provides a framework for continuous process improvement

from SEI Training